Rec'd PCT/PTO 28 MAR 2002

FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	220802US2XPCT
	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR **10/088503**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/05151	**31 July 2000**	**None**

TITLE OF INVENTION
OPTICAL WAVELENGTH DIVISION MULTIPLEXING AND TRANSMISSION APPARATUS

APPLICANT(S) FOR DO/EO/US
YAMANAKA Shigeo et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

   Drawings (6 sheets)/PCT/IB/308
   Cited References (2)/Form PTO-1449

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U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 10/088503	INTERNATIONAL APPLICATION NO. PCT/JP00/05151	ATTORNEY'S DOCKET NUMBER 220802US2XPCT

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS	PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	8 - 20 =	0	x $18.00	**$0.00**	
Independent claims	3 - 3 =	0	x $84.00	**$0.00**	
Multiple Dependent Claims **(check if applicable).**			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$890.00**	
☐ Applicant claims small entity status. See 37 CFR 1 27). The fees indicated above are reduced by 1/2.				**$0.00**	
SUBTOTAL =				**$890.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$890.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$890.00**	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **$890.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. ________ in the amount of ________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Surinder Sachar
Registration No. 34,423

22850

Surinder Sachar
SIGNATURE

Marvin J. Spivak
NAME

24,913
REGISTRATION NUMBER

March 28 2002
DATE

220802US

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: :

SHIGEO YAMANAKA ET AL. :

SERIAL NO: NEW U.S. PCT APPLN. : ATTN: APPLICATION BRANCH
(Based on PCT/JP00/05151)

FILED: HEREWITH :

FOR: OPTICAL WAVELENGTH DIVISION MULTIPLEXING AND TRANSMISSION APPARATUS

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to a first examination on the merits, please amend the above-identified application as follows:

IN THE CLAIMS

Please amend Claims 1-3 to read as follows:[1]

1. (Amended) An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, and a synthetic optical

[1]A marked-up copy of the claim amendments is attached hereto.

wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a synthetic multiplexed signal is output, and

a structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal, and an optical amplifier in which the second multiplexed signal output from the second optical wavelength multiplexer is multiplied.

2. (Amended) An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a synthetic optical wavelength demultiplexer in which a synthetic multiplexed signal formed by multiplexing a plurality of multiplexed signals, which are respectively formed of a plurality of groups of optical wavelength signals having a plurality of optical wavelength distributions different from each other, with each other is received, the synthetic multiplexed signal is demultiplexed to both a first multiplexed signal and a second multiplexed signal and both the first multiplexed signal and the second multiplexed signal are output, and a first optical wavelength demultiplexer in which the first multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of one group and the group of optical wavelength signals is output, and

a structure body of the slave rack accommodates a second optical wavelength demultiplexer in which the second multiplexed signal output by the synthetic optical

wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output, and an optical amplifier in which the second multiplexed signal output from the second optical wavelength multiplexer is multiplied.

3. (Amended) An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a first synthetic multiplexed signal is output, a synthetic optical wavelength demultiplexer in which a second synthetic optical wavelength transmitted from another optical wavelength division multiplexing and transmission apparatus of an opposite end through an optical transmission line is demultiplexed to both a third multiplexed signal and a fourth multiplexed signal and both the third multiplexed signal and the fourth multiplexed signal are output, and a first optical wavelength demultiplexer in which the third multiplexed signal output from synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of a group and the group of optical wavelength signals is output, and

a structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength

distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal, and a second optical wavelength demultiplexer in which the fourth multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output, and an optical amplifier in which the second multiplexed signal output from the second optical wavelength multiplexer is multiplied.

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

The present preliminary amendment is submitted to clarify features in Claims 1-3, which features are believed to be self-evident from the original disclosure, and thus are not deemed to raise any issues of new matter.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

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220802US

Marked-Up Copy
Serial No:
____
Amendment Filed on:
3-28-2002

IN THE CLAIMS

Please amend the claims as follows:

--1. (Amended) An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, and a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a synthetic multiplexed signal is output, and

a structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal, and an optical amplifier in which the second multiplexed signal output from the second optical wavelength multiplexer is multiplied.

2. (Amended) An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a synthetic optical wavelength demultiplexer in which a synthetic multiplexed signal formed by multiplexing a plurality of multiplexed signals, which are respectively formed of a plurality of groups of optical wavelength signals having a plurality of optical wavelength distributions different from each other, with each other is received, the synthetic multiplexed signal is demultiplexed to both a first multiplexed signal and a second multiplexed signal and both the first multiplexed signal and the second multiplexed signal are output, and a first optical wavelength demultiplexer in which the first multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of one group and the group of optical wavelength signals is output, and

a structure body of the slave rack accommodates a second optical wavelength demultiplexer in which the second multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output<u>, and an optical amplifier in which the second multiplexed signal output from the second optical wavelength multiplexer is multiplied</u>.

3. (Amended) An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are

multiplexed with each other and a first multiplexed signal is output, a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a first synthetic multiplexed signal is output, a synthetic optical wavelength demultiplexer in which a second synthetic optical wavelength transmitted from another optical wavelength division multiplexing and transmission apparatus of an opposite end through an optical transmission line is demultiplexed to both a third multiplexed signal and a fourth multiplexed signal and both the third multiplexed signal and the fourth multiplexed signal are output, and a first optical wavelength demultiplexer in which the third multiplexed signal output from synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of a group and the group of optical wavelength signals is output, and

a structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal, and a second optical wavelength demultiplexer in which the fourth multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output, and an optical amplifier in which the second multiplexed signal output from the second optical wavelength multiplexer is multiplied.--

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SPECIFICATION

TITLE OF THE INVENTION

OPTICAL WAVELENGTH DIVISION MULTIPLEXING AND TRANSMISSION APPARATUS

TECHNICAL FIELD

The present invention relates to an optical wavelength division multiplexing and transmission apparatus adapted for a wavelength division multiplexing and transmission system in which a plurality of optical wavelength signals having wavelengths different from each other are multiplexed and transmitted.

BACKGROUND ART

Fig. 1 is a block diagram showing the configuration of a conventional optical wavelength division multiplexing and transmission apparatus. In Fig. 1, 101 indicates a transmitter end rack. 102 indicates a rack of a receiver end. The transmitter end rack 101 accommodates an optical wavelength multiplexer 111 and an amplifier 112. A plurality of input optical wavelength signals are multiplexed in the optical wavelength multiplexer 111, and an output of the optical wavelength multiplexer 111 is optically-amplified in the amplifier 112. The receiver end rack 102 accommodates an amplifier 114 and an optical wavelength demultiplexer 115. A multiplexed signal is transmitted and optically-amplified in the amplifier 114, and an output of the amplifier 114 is demultiplexed in the optical wavelength demultiplexer 115 to a plurality of optical wavelength signals having wavelengths different from each other. 113 indicates an optical transmission line formed of an optical fiber which connects the transmitter end rack 101 and the receiver end rack 102. A plurality of optical relaying units are normally placed at appropriate positions

of the optical transmission line 113. However, the optical relaying units are omitted in this specification to simplify the description.

Next, an operation will be described below.

In a wavelength division multiplexing and transmission system (hereinafter, called WDM transmission system), a large number of types of information are respectively assigned to a plurality of optical wavelength signals having wavelengths different from each other to convert the types of information into the optical wavelength signals. In the transmitter end rack 101, the converted optical wavelength signals λ1, λ2, λ3,··· and λn are taken out from the optical wavelength multiplexer 111 as a multiplexed signal. This multiplexed signal is amplified in the amplifier 112 and is sent out to the optical transmission line 113. In the receiver end rack 102, the multiplexed signal transmitted through the optical transmission line 113 is amplified in the amplifier 114 and is demultiplexed to the optical wavelength signals λ1, λ2, λ3,··· and λn having wavelengths different from each other in the optical wavelength demultiplexer 115. The optical wavelength signals λ1, λ2, λ3,··· and λn taken out from the optical wavelength demultiplexer 115 are demodulated in a latter stage to a plurality of electric signals denoting the types of original information.

Because the conventional optical wavelength division multiplexing and transmission apparatus has the above-described configuration, it is not easy to expand a multiplex function so as to increase the number of optical wavelength signals. A plurality of wavelengths of a plurality of optical wavelength signals multiplexed in an optical wavelength multiplexer are set to be placed at wavelength intervals so as not to interfere with each other. Therefore, in cases where the number of optical wavelength signals multiplexed with each other is increased due to the increase of a quantity of information to be

transmitted, wavelengths assigned to pieces of information and possible to be processed in both an optical wavelength multiplexer and an optical wavelength demultiplexer run short. In this case, it is required to replace both the optical wavelength multiplexer and the optical wavelength demultiplexer with both another optical wavelength multiplexer and another optical wavelength demultiplexer in which additional optical wavelength signals can be received and processed. However, because both the optical wavelength multiplexer and the optical wavelength demultiplexer set in operation are taken out from the conventional optical wavelength division multiplexing and transmission apparatus, the communication is interrupted during the replacement. Therefore, a problem has arisen that it is not easy to actually perform the replacement.

The present invention is provided to solve the above-described problem, and the object of the present invention is to provide an optical wavelength division multiplexing and transmission apparatus in which both an optical wavelength multiplexer and an optical wavelength demultiplexer for an early operation are installed at an processing capacity corresponding to a prescribed number of optical wavelength signals to suppress an initial cost and a plurality of groups of other optical wavelength multiplexers and other optical wavelength demultiplexers suitable for the demand of communication are additionally installed one after another while maintaining a communication condition.

DISCLOSURE OF THE INVENTION

An optical wavelength division multiplexing and transmission apparatus according to the present invention comprises a master rack and at least a slave rack possible to be combined with and coupled to the master rack. A structure body of the master rack accommodates

a first optical wavelength multiplexer, in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, and a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a synthetic multiplexed signal is output. A structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal.

Therefore, in the WDM transmission system, in cases where the number of optical wavelength signals multiplexed is small in the early operation and it is expected that the number of optical wavelength signals multiplexed is increased in the future, the optical wavelength signals are divided in advance into a plurality of groups, and the slave rack is additionally installed for each group without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

An optical wavelength division multiplexing and transmission apparatus according to the present invention comprises a master rack and at least a slave rack possible to be combined with and coupled to the master rack. A structure body of the master rack accommodates a synthetic optical wavelength demultiplexer in which a synthetic multiplexed signal formed by multiplexing a plurality of multiplexed signals, which are respectively formed of a plurality of groups of

optical wavelength signals having a plurality of optical wavelength distributions different from each other, with each other is received, the synthetic multiplexed signal is demultiplexed to both a first multiplexed signal and a second multiplexed signal and both the first multiplexed signal and the second multiplexed signal are output, and a first optical wavelength demultiplexer in which the first multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of one group and the group of optical wavelength signals is output. A structure body of the slave rack accommodates a second optical wavelength demultiplexer in which the second multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output.

Therefore, a plurality of slave racks can be additionally installed one after another on a receiver end without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

An optical wavelength division multiplexing and transmission apparatus according to the present invention comprises a master rack and at least a slave rack possible to be combined with and coupled to the master rack. A structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a first synthetic multiplexed signal is output, a synthetic optical

wavelength demultiplexer in which a second synthetic optical wavelength transmitted from another optical wavelength division multiplexing and transmission apparatus of an opposite end through an optical transmission line is demultiplexed to both a third multiplexed signal and a fourth multiplexed signal and both the third multiplexed signal and the fourth multiplexed signal are output, and a first optical wavelength demultiplexer in which the third multiplexed signal output from synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of a group and the group of optical wavelength signals is output. A structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal, and a second optical wavelength demultiplexer in which the fourth multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output.

Therefore, because each of the master rack and the slave rack has both a function of multiplying the optical wavelength signals and a function of demultiplying the multiplexed signal, the functions can be simultaneously added in the additional installation. Also, a plurality of slave racks can be additionally installed one after another on a receiver end without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

On a transmitter end, an optical wavelength division multiplexing

and transmission apparatus according to the present invention further comprises a plurality of noise cut filters corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

Therefore, because only effective wavelength components are taken out from the multiplexed signals and are transmitted, the transmission quality of the multiplexed signals can be improved. Also, a plurality of slave racks can be additionally installed one after another on the transmitter end without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

On a transceiver side, an optical wavelength division multiplexing and transmission apparatus according to the present invention further comprises a plurality of noise cut filters corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

Therefore, only effective wavelength components can be taken out of the multiplexed signals in the transmission operation and can be transmitted. Also, because each rack has both the transmission function and the reception function, the functions can be simultaneously added in the additional installation, and a plurality of slave racks can be additionally installed one after another without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various

purposes.

On a transmitter end, an optical wavelength division multiplexing and transmission apparatus according to the present invention further comprises a plurality of dispersion compensation fibers corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

Therefore, the distortion of effective wavelength components of the multiplexed signals given by an optical fiber of the transmission line can be compensated, and the transmission quality of the multiplexed signals can be heightened. Also, a plurality of slave racks can be additionally installed one after another in the transmitter without stopping the system for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

On a transceiver side, an optical wavelength division multiplexing and transmission apparatus according to the present invention further comprises a plurality of dispersion compensation fibers corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

Therefore, the distortion of effective wavelength components of the multiplexed signals given by an optical fiber of a transmission line can be compensated, and the transmission quality of the multiplexed signals can be heightened. Also, because each rack has both the transmission function and the reception function, the functions can be simultaneously added in the additional installation, and a

plurality of slave racks can be additionally installed one after another without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

An optical wavelength division multiplexing and transmission apparatus according to the present invention further comprises an amplifier of the master rack for the first multiplexed signal, an amplifier of the master rack for the synthetic multiplexed signal, a wavelength level monitoring device of the master rack for monitoring an output of the amplifier for the synthetic multiplexed signal, an amplifier of the slave rack for the second multiplexed signal, and a plurality of output control circuits for selectively controlling a plurality of levels of signals output from the amplifier for the first multiplexed signal, the amplifier for the second multiplexed signal and the amplifier for the synthetic multiplexed signal respectively in response to a detection output of the wavelength level monitoring device in which a plurality of levels of the optical wavelength signals of the first multiplexed signal, the second multiplexed signal and the synthetic multiplexed signal are monitored.

Therefore, level differences among the multiplexed signals of the groups of the optical wavelength signals can be corrected before the signal transmission, and the transmission qualities of the multiplexed signals can be equally maintained. Also, as the transmitter, a plurality of slave racks can be additionally installed one after another without stopping the system installed for the early operation in the additional installation. Accordingly, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing the configuration of a conventional optical wavelength division multiplexing and transmission apparatus.

Fig. 2 is a block diagram showing an optical wavelength division multiplexing and transmission apparatus according to a first embodiment of the present invention.

Fig. 3 is a block diagram showing an optical wavelength division multiplexing and transmission apparatus according to a second embodiment of the present invention.

Fig. 4 is a block diagram showing an optical wavelength division multiplexing and transmission apparatus according to a third embodiment of the present invention.

Fig. 5 is a block diagram showing an optical wavelength division multiplexing and transmission apparatus according to a fourth embodiment of the present invention.

Fig. 6 is a block diagram showing an optical wavelength division multiplexing and transmission apparatus according to a fifth embodiment of the present invention.

Fig. 7 is a block diagram showing an optical wavelength division multiplexing and transmission apparatus according to a sixth embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, the best mode for carrying out the present invention will now be described with reference to the accompanying drawings to explain the present invention in more detail.

EMBODIMENT 1

A block diagram of the configuration of a transmission side of an optical wavelength division multiplexing and transmission apparatus

is shown in Fig. 2. In Fig. 2, 20 indicates a master rack. 30 indicates a slave rack possible to be combined with and coupled to the master rack 20. Though a plurality of slave racks 30 can be additionally installed according to a scale of an optical circuit placed in the master rack 20, to simplify the description, one slave rack 30 of the smallest number is shown.

A structure body of the master rack 20 accommodates an optical wavelength multiplexer (or first optical wavelength multiplexer) 21, an amplifier 22, an amplifier 24 and a synthetic optical wavelength multiplexer 23 integrally placed with each other. Also, a structure body of the slave rack 30 accommodates an optical wavelength multiplexer (or second optical wavelength multiplexer) 31 and an amplifier 32 integrally placed with each other. The slave rack 30 is coupled to the master rack 20, and an optical output of the slave rack 30 is input to the synthetic optical wavelength multiplexer 23 through an optical connector 25. In the same manner, the same type of slave rack as that of the slave rack 30 can be connected to an optical connector 26. Here, the master rack 20 has an interface so as to prevent the influence occurring in the additional installation of another slave rack 30.

In the master rack 20, a plurality of optical wavelength signals $\lambda 1, \lambda 2, \cdots$ and λn of one group formed in a prescribed optical wavelength distribution are input and multiplexed in the optical wavelength multiplexer 21. Thereafter, a multiplexed signal (or first multiplexed signal) output from the optical wavelength multiplexer 21 is amplified to a prescribed level in the amplifier 22 and is input to the synthetic optical wavelength multiplexer 23. In cases where the slave rack 30 is not connected to the master rack 20, the multiplexed signal input to the synthetic optical wavelength multiplexer 23 is output from the synthetic optical wavelength

multiplexer 23 as a synthetic multiplexed signal without processing the multiplexed signal and is transmitted to a receiver of the opposite end through both the amplifier 24 and an optical transmission line 113. As is described above, in cases where the number of optical wavelength signals to be transmitted is small in the early stage in which the WDM transmission system is structured, only the master rack 20 is installed and operated.

In cases where the increase of the number of optical wavelength signals to be transmitted is required due to the increase of a quantity of information, the multiplex and transmission capability of only the master rack 20 currently set in operation is not sufficient. In this case, the slave rack 30 is coupled to the master rack 20. In this coupling operation, though the amplifier 32 is connected to the synthetic optical wavelength multiplexer 23 through the optical connector 25, the transmission function of the master rack 20 currently operated is not stopped. A group of a plurality of optical wavelength signals $\lambda n+1$, $\lambda n+2$, $\cdots$ and λm, which are input to the optical wavelength multiplexer 31 and are multiplexed, is formed to have a wavelength distribution different from that of the group of optical wavelength signals $\lambda 1$, $\lambda 2$, $\cdots$ and λn. A multiplexed signal (or second multiplexed signal) output from the optical wavelength multiplexer 31 is amplified in the amplifier 32 and is fed to the synthetic optical wavelength multiplexer 23 of the master rack 20. Thereafter, the multiplexed signal is multiplexed with other multiplexed signals and is transmitted to the receiver of the opposite end as a synthetic multiplexed signal.

As is described above, in the first embodiment, the slave rack 30 can be easily and additionally installed in the optical wavelength division multiplexing and transmission apparatus without stopping the operation of the system installed for the early operation system.

Accordingly, in the WDM transmission system, in cases where the number of optical wavelength signals multiplexed with each other is small in the early operation and it is expected that the number of optical wavelength signals multiplexed with each other is increased in the future, the optical wavelength signals increased in the future are divided in advance into a plurality of groups, and the slave rack 30 can be additionally installed for each group. Therefore, the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

EMBODIMENT 2

A block diagram of the configuration of a reception side of an optical wavelength division multiplexing and transmission apparatus is shown in Fig. 3. In Fig. 3, 40 indicates a master rack. The master rack 40 accommodates an amplifier 41, an amplifier 43, a synthetic optical wavelength demultiplexer 42 and an optical wavelength demultiplexer (or first optical wavelength demultiplexer) 44. 50 indicates a slave rack. The slave rack 50 accommodates an amplifier 51 and an optical wavelength demultiplexer (or second optical wavelength demultiplexer) 52. The slave rack 50 can be coupled to the master rack 40 at any time. In cases where the slave rack 50 is additionally installed, an optical signal of the master rack 40 is couple to the slave rack 50 through an optical connector 45. The master rack 40 or the slave rack 50 has an interface to perform this signal coupling.

Next, an operation will be described below.

A synthetic multiplexed signal, which is transmitted from an opposite end transmitter having the configuration shown in Fig. 2 through the optical transmission line 113, is amplified in the amplifier 41 and is input to the synthetic optical wavelength demultiplexer 42. Here, a plurality of optical wavelength signals λ

1, λ2,··· and λn of wavelengths different from each other and having an optical wavelength distribution are multiplexed with each other to form a multiplexed signal, a plurality of optical wavelength signals λn+1, λn+2,··· and λm having wavelengths different from each other and having an optical wavelength distribution different from that of the group of the optical wavelength signals λ1, λ2,··· and λn are multiplexed with each other to form another multiplexed signal, and the synthetic multiplexed signal is formed by multiplexing the multiplexed signals with each other. A multiplexed signal (or first multiplexed signal) formed by the demultiplexing of the synthetic optical wavelength demultiplexer 42 is amplified in the amplifier 43 and is input to the optical wavelength demultiplexer (or first optical wavelength demultiplexer) 44. Thereafter, the multiplexed signal is demultiplexed to the optical wavelength signals λ1, λ2,··· and λn of one group in the optical wavelength demultiplexer 44, and the group of the optical wavelength signals λ1, λ2,··· and λn is sent to a circuit of a latter stage. In cases where the slave rack 50 is additionally installed due to the increase of a quantity of information to be transmitted, another multiplexed signal (or second multiplexed signal) formed by the demultiplexing of the synthetic optical wavelength demultiplexer 42 is fed to the amplifier 51 through the optical connector 45 and is amplified. Thereafter, the multiplexed signal is input to the optical wavelength demultiplexer (or second optical wavelength demultiplexer) 52 and is demultiplexted to the optical wavelength signals λn+1, λn+2,··· and λm of one group.

As is described above, in the second embodiment, the receiver end of the optical wavelength division multiplexing and transmission apparatus has the configuration in which the slave rack 50 can be additionally installed. Accordingly, the slave rack 50 can be easily and additionally installed in the optical wavelength division

multiplexing and transmission apparatus without stopping the operation of the system installed for the early operation, and the optical wavelength division multiplexing and transmission apparatus can be widely used for various purposes.

EMBODIMENT 3

A block diagram of the configuration of an optical wavelength division multiplexing and transmission apparatus, in which circuits of a transmission function and circuits of a reception function are integrally formed, is shown in Fig. 4. In Fig. 4, circuits of a transmission function, which are the same as those shown in Fig. 2, are indicated by the same reference numerals as those of the constituent elements shown in Fig. 2, and circuits of a reception function, which are the same as those shown in Fig. 3, are indicated by the same reference numerals as those of the constituent elements shown in Fig. 3.

120 indicates an optical transmission line through which a synthetic multiplexed signal (or first synthetic multiplexed signal) of the synthetic optical wavelength multiplexer 23 is transmitted to a receiver of the opposite end. 140 indicates an optical transmission line through which a synthetic multiplexed signal (or first synthetic multiplexed signal) of a transmitter of the opposite end is transmitted. A master rack 200 indicates a receiving and transmitting system installed for the early operation. A slave rack 300 is coupled to the master rack 200 in cases where the number of optical wavelength signals processed is increased, and a transmitting and receiving function is expanded by the slave rack 300. Here, because a wavelength distribution of a group of optical wavelength signals denoting an input of the optical wavelength multiplexer (or first optical wavelength multiplexer) 21 is the same that denoting an output of optical

wavelength demultiplexer (or first optical wavelength demultiplexer) 44, the optical wavelength signals denoting the input of the optical wavelength multiplexer 21 are indicated by the same reference numerals $\lambda 1$, $\lambda 2$,⋯ and λn as those denoting the output of optical wavelength demultiplexer 44. In the same manner, in the slave rack 300, a plurality of optical wavelength signals denoting the input are indicated by the same reference numerals $\lambda n+1$, $\lambda n+2$,⋯ and λm as those denoting the output.

In the master rack 200, a plurality of optical wavelength signals $\lambda 1$, $\lambda 2$,⋯ and λn are multiplexed in the optical wavelength multiplexer 21, and a multiplexed signal (or first multiplexed signal) is output from the optical wavelength multiplexer 21. This multiplexed signal is amplified in the amplifier 22 and is fed to the synthetic optical wavelength multiplexer 23. In the synthetic optical wavelength multiplexer 23, the multiplexed signal is multiplexed with the same type of multiplexed signal (or second multiplexed signal) as that of the multiplexed signal to obtain a synthetic multiplexed signal (or first synthetic multiplexed signal), and the synthetic multiplexed signal is output to the optical transmission line 120 through the amplifier 24. In the synthetic optical wavelength demultiplexer 42, after a synthetic multiplexed signal (or second synthetic multiplexed signal), which is transmitted from another optical wavelength division multiplexing and transmission apparatus of the opposite end through the optical transmission line 140, is amplified in the amplifier 41, the synthetic multiplexed signal is input and demultiplexted to a plurality of multiplexed signals. One multiplexed signal (or third multiplexed signal) demultiplexted in the synthetic optical wavelength demultiplexer 42 is amplified in the amplifier 43. Thereafter, the multiplexed signal is input to the optical wavelength demultiplexer (or first optical wavelength demultiplexer) 44 and is

demultiplexed to the optical wavelength signals λ1, λ2,⋯ and λn of one group.

Also, in cases where the slave rack 300 is coupled to the master rack 200, a plurality of optical wavelength signals λn+1, λn+2,⋯ and λm having a wavelength distribution different from that of the optical wavelength signals λ1, λ2,⋯ and λn are multiplexed with each other in the optical wavelength multiplexer (or second optical wavelength multiplexer) 31, and a multiplexed signal (or second multiplexed signal) is fed to the synthetic optical wavelength multiplexer 23 of the master rack 200 through the amplifier 32. Also, another multiplexed signal, which is formed by demultiplexing the synthetic multiplexed signal transmitted through the optical transmission line 140 in the synthetic optical wavelength demultiplexer 42, is demultiplexed to the optical wavelength signals λn+1, λn+2,⋯ and λm in the optical wavelength demultiplexer (or second optical wavelength demultiplexer) 52, and the optical wavelength signals λn+1, λn+2, ⋯ and λm is output.

As is described above, in the third embodiment, when the slave rack 300 is additionally installed in the optical wavelength division multiplexing and transmission apparatus, the slave rack 300 can be easily and additionally installed without stopping the operation of the system installed for the early operation. Also, because each of the master rack 200 and the slave rack 300 accommodates circuits of an optical multiplexing function and circuits of an optical demultiplexing function, the circuits of the optical multiplexing function and the circuits of the optical demultiplexing function in the slave rack 300 can be simultaneously and additionally installed in the optical wavelength division multiplexing and transmission apparatus, and workability can be further improved in the optical wavelength division multiplexing and transmission apparatus.

EMBODIMENT 4

A block diagram of the configuration of an optical wavelength division multiplexing and transmission apparatus, in which an additional circuit is installed on the transmitter end, is shown in Fig. 5. In Fig. 5, the additional circuit is formed of a plurality of noise cut filters 201, 202 and 203 installed on the input side of the synthetic optical wavelength multiplexer 23.

When the group of optical wavelength signals $\lambda 1$, $\lambda 2$,$\cdots$ and λn multiplexed in the first optical wavelength multiplexer 21 is multiplexed in the synthetic optical wavelength multiplexer 23 with the group of optical wavelength signals $\lambda n+1$, $\lambda n+2$,$\cdots$ and λm multiplexed in the optical wavelength multiplexer 31, noise components included in the groups of optical wavelength signals are added to each other so as to increase a noise level, and an S/N ratio of the synthetic multiplexed signal is lowered. To prevent the lowering of the S/N ratio, a band of a prescribed band width is set for each group of optical wavelength signals, and unnecessary signal components existing outside the band are cut away in each of the noise cut filters 201, 202 and 203. In Fig. 5, the noise cut filters 201, 202 and 203 are installed in the master rack 20. However, it is applicable that the noise cut filters 202 and 203 be installed in the slave racks 30 respectively. Also, the installation of the noise cut filters 201, 202 and 203 can be adapted for the optical wavelength division multiplexing and transmission apparatus of Fig. 4 functioning as a transceiver.

As is described above, in the fourth embodiment, the noise cut filters 201, 202 and 203 are inserted into the optical wavelength division multiplexing and transmission apparatus so as to transmit only an effective wavelength portion of each group of optical wavelength

signals through the corresponding noise cut filter. Therefore, communication quality of the optical wavelength division multiplexing and transmission apparatus can be improved.

EMBODIMENT 5

A block diagram of the configuration of an optical wavelength division multiplexing and transmission apparatus, in which a plurality of dispersion compensation fibers 205, 206 and 207 are installed on the receiver end as an additional circuit, is shown in Fig. 6. In detail, the dispersion compensation fibers 205, 206 and 207 are installed on the input side of the synthetic optical wavelength multiplexer 23 of the master rack 20.

When each optical wavelength signal is transmitted through an optical fiber of a transmission line, a wavelength distortion occurs in the optical wavelength signal due to the dispersion of the optical wavelength signal peculiar to the optical fiber. Therefore, the transmission quality of the optical wavelength signal is lowered. To prevent the lowering of the transmission quality, each multiplexed signal is fed to the synthetic optical wavelength multiplexer 23 through the corresponding dispersion compensation fiber 205, 206 or 207 so as to compensate for the dispersion of the multiplexed signal expected to be accumulated in an optical fiber of a transmission line. Each of the dispersion compensation fibers 205, 206 and 207 has a function of preventing the dispersion of the multiplexed signal occurring in an optical fiber of a transmission line, and the distortion of each optical wavelength signal can be prevented. Here, in the same manner as the installation of the noise cut filters 202 and 203, it is applicable that the dispersion compensation fibers 206 and 207 be installed in the slave racks 30 respectively. Also, the installation of the dispersion compensation fibers 205, 206 and 207

can be adapted for the optical wavelength division multiplexing and transmission apparatus of Fig. 4 functioning as a transceiver.

As is described above, the dispersion compensation fibers 205, 206 and 207 are inserted into the optical wavelength division multiplexing and transmission apparatus, and the communication quality of the WDM transmission system can be improved.

EMBODIMENT 6

A block diagram of the configuration of an optical wavelength division multiplexing and transmission apparatus, in which a wavelength level monitoring device 208 and a plurality of output control circuits 209, 210 and 211 are installed on the receiver end as an additional circuit, is shown in Fig. 7.

In the master rack 20, the wavelength level monitoring device 208 has a function of monitoring levels of the optical wavelength signals of the synthetic multiplexed signal which is output from the amplifier 24. A monitored level of each optical wavelength signal detected in the wavelength level monitoring device 208 is fed back to the corresponding amplifier 22 or 32 through the corresponding output control circuit 209 or 210 installed in the master rack 20 or the slave rack 30, and the output control circuits 209 and 210 control the amplifiers 22 and 32 respectively to equalize levels of the optical wavelength signals of the multiplexed signals (or first and second multiplexed signals) with each other. Also, the output control circuit 211 controls the amplifier 24 to set a level of the synthetic multiplexed signal output from the amplifier 24 of the final stage to a predetermined value.

As is described above, in the sixth embodiment, level differences among the multiplexed signals of the groups of optical wavelength signals can be corrected before the signal transmission, and the

transmission qualities of the multiplexed signals can be equally maintained.

INDUSTRIAL APPLICABILITY

As is described above, an optical wavelength division multiplexing and transmission apparatus according to the present invention has the configuration in which a plurality of slave racks coupling to a master rack can be additionally installed one after another with the master rack. Therefore, in cases where it is desired to expand a function of a transmitter and a function of a receiver due to the increase of a quality of information to be transmitted, the additional installation of the slave rack can be performed without exerting influence on a communication means installed in advance and currently used. Accordingly, it can be expected that the optical wavelength division multiplexing and transmission apparatus is adapted for the optical communication service which is more and more increased in the future.

WHAT IS CLAIMED IS:

1. An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, and a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a synthetic multiplexed signal is output, and

a structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal.

2. An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a synthetic optical wavelength demultiplexer in which a synthetic multiplexed signal formed by multiplexing a plurality of multiplexed signals, which are respectively formed of a plurality of groups of optical wavelength signals having a plurality of optical wavelength distributions different from each other, with each other is received, the synthetic multiplexed signal is demultiplexed to both a first multiplexed signal and a second multiplexed signal and both the first multiplexed signal

and the second multiplexed signal are output, and a first optical wavelength demultiplexer in which the first multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of one group and the group of optical wavelength signals is output, and

a structure body of the slave rack accommodates a second optical wavelength demultiplexer in which the second multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output.

3. An optical wavelength division multiplexing and transmission apparatus, comprising a master rack and at least a slave rack possible to be combined with and coupled to the master rack, wherein

a structure body of the master rack accommodates a first optical wavelength multiplexer in which a plurality of prescribed optical wavelength signals of a group are multiplexed with each other and a first multiplexed signal is output, a synthetic optical wavelength multiplexer in which the first multiplexed signal output from the first optical wavelength multiplexer and a second multiplexed signal are multiplexed with each other and a first synthetic multiplexed signal is output, a synthetic optical wavelength demultiplexer in which a second synthetic optical wavelength transmitted from another optical wavelength division multiplexing and transmission apparatus of an opposite end through an optical transmission line is demultiplexed to both a third multiplexed signal and a fourth multiplexed signal and both the third multiplexed signal and the fourth multiplexed signal are output, and a first optical wavelength demultiplexer in which the third multiplexed signal output from synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength

signals of a group and the group of optical wavelength signals is output, and

a structure body of the slave rack accommodates a second optical wavelength multiplexer in which a plurality of optical wavelength signals of a group having a wavelength distribution different from that of the group of prescribed optical wavelength signals multiplexed by the first optical wavelength multiplexer are multiplexed with each other and are output as the second multiplexed signal, and a second optical wavelength demultiplexer in which the fourth multiplexed signal output by the synthetic optical wavelength demultiplexer is demultiplexed to a plurality of optical wavelength signals of another group and the group of optical wavelength signals is output.

4. An optical wavelength division multiplexing and transmission apparatus according to claim 1, further comprising a plurality of noise cut filters corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

5. An optical wavelength division multiplexing and transmission apparatus according to claim 3, further comprising a plurality of noise cut filters corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

6. An optical wavelength division multiplexing and transmission apparatus according to claim 1, further comprising a plurality of dispersion compensation fibers corresponding to the first multiplexed

signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

7. An optical wavelength division multiplexing and transmission apparatus according to claim 3, further comprising a plurality of dispersion compensation fibers corresponding to the first multiplexed signal and the second multiplexed signal respectively on an input side of the synthetic optical wavelength multiplexer on which the first multiplexed signal and the second multiplexed signal are input.

8. An optical wavelength division multiplexing and transmission apparatus according to claim 1, further comprising an amplifier of the master rack for the first multiplexed signal, an amplifier of the master rack for the synthetic multiplexed signal, a wavelength level monitoring device of the master rack for monitoring an output of the amplifier for the synthetic multiplexed signal, an amplifier of the slave rack for the second multiplexed signal, and a plurality of output control circuits for selectively controlling a plurality of levels of signals output from the amplifier for the first multiplexed signal, the amplifier for the second multiplexed signal and the amplifier for the synthetic multiplexed signal respectively in response to a detection output of the wavelength level monitoring device in which a plurality of levels of the optical wavelength signals of the first multiplexed signal, the second multiplexed signal and the synthetic multiplexed signal are monitored.

ABSTRACT OF THE DISCLOSURE

A transmitter, a receiver or a transceiver is formed of a master rack 20 or 200 and a slave rack 30 or 300 possible to be coupled to the master rack, a prescribed number of optical wavelength signals are processed in the master rack in the early operation, and a plurality of slave racks coupled to the master rack are additionally installed one after another according to the increasing demand of the optical wavelength signals without damaging the early operation.

FIG.1

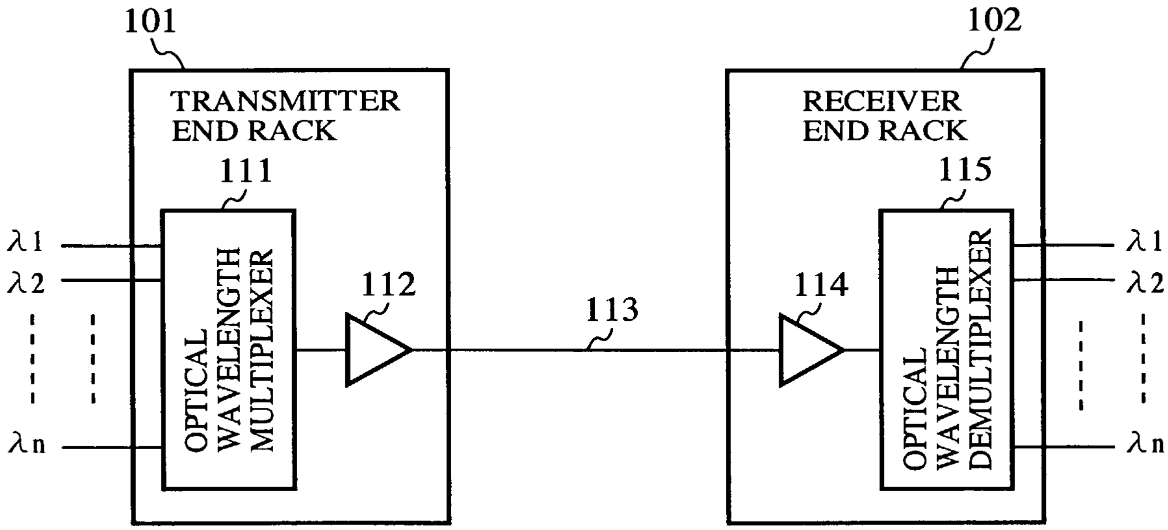

101
TRANSMITTER END RACK
111
OPTICAL WAVELENGTH MULTIPLEXER
112
λ1
λ2
λn
113
102
RECEIVER END RACK
115
114
OPTICAL WAVELENGTH DEMULTIPLEXER
λ1
λ2
λn

FIG.2

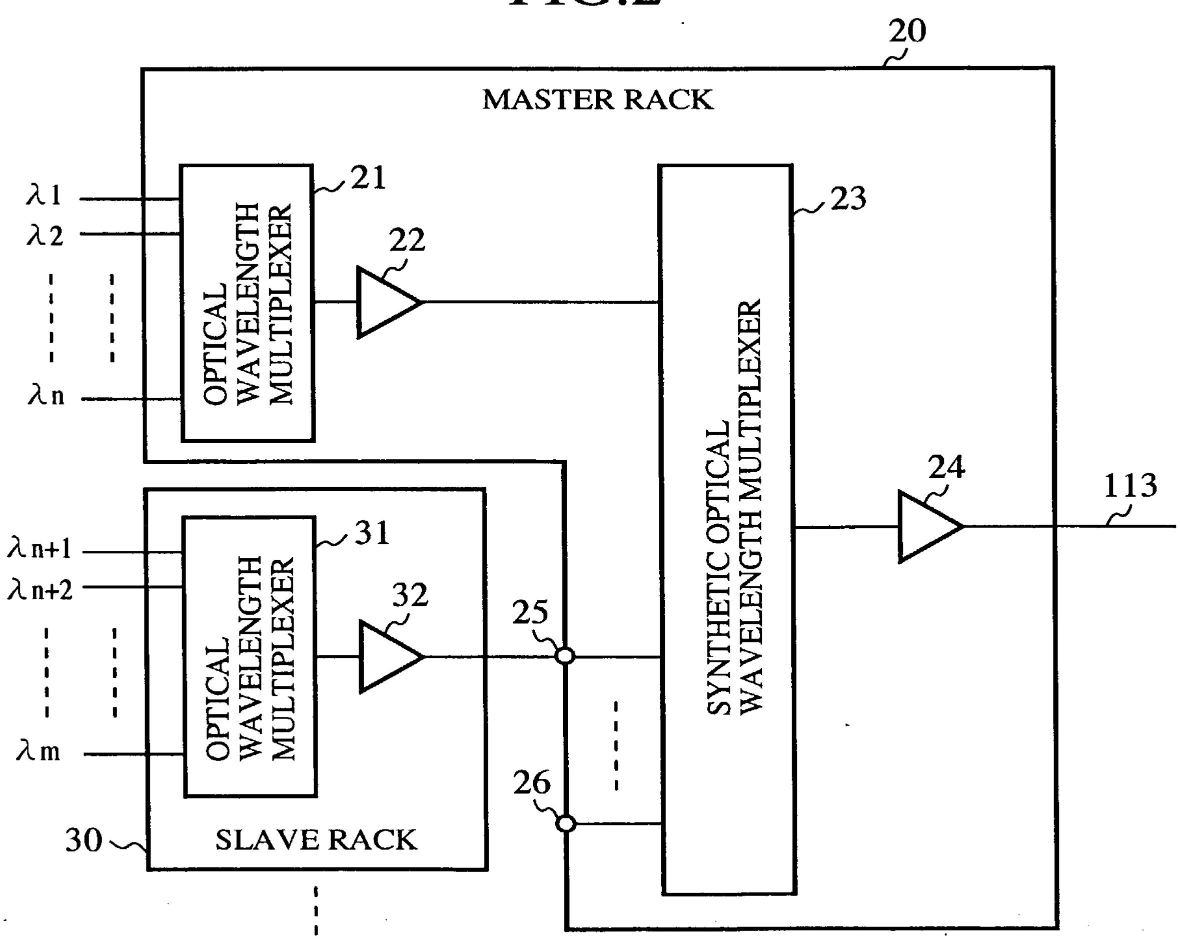
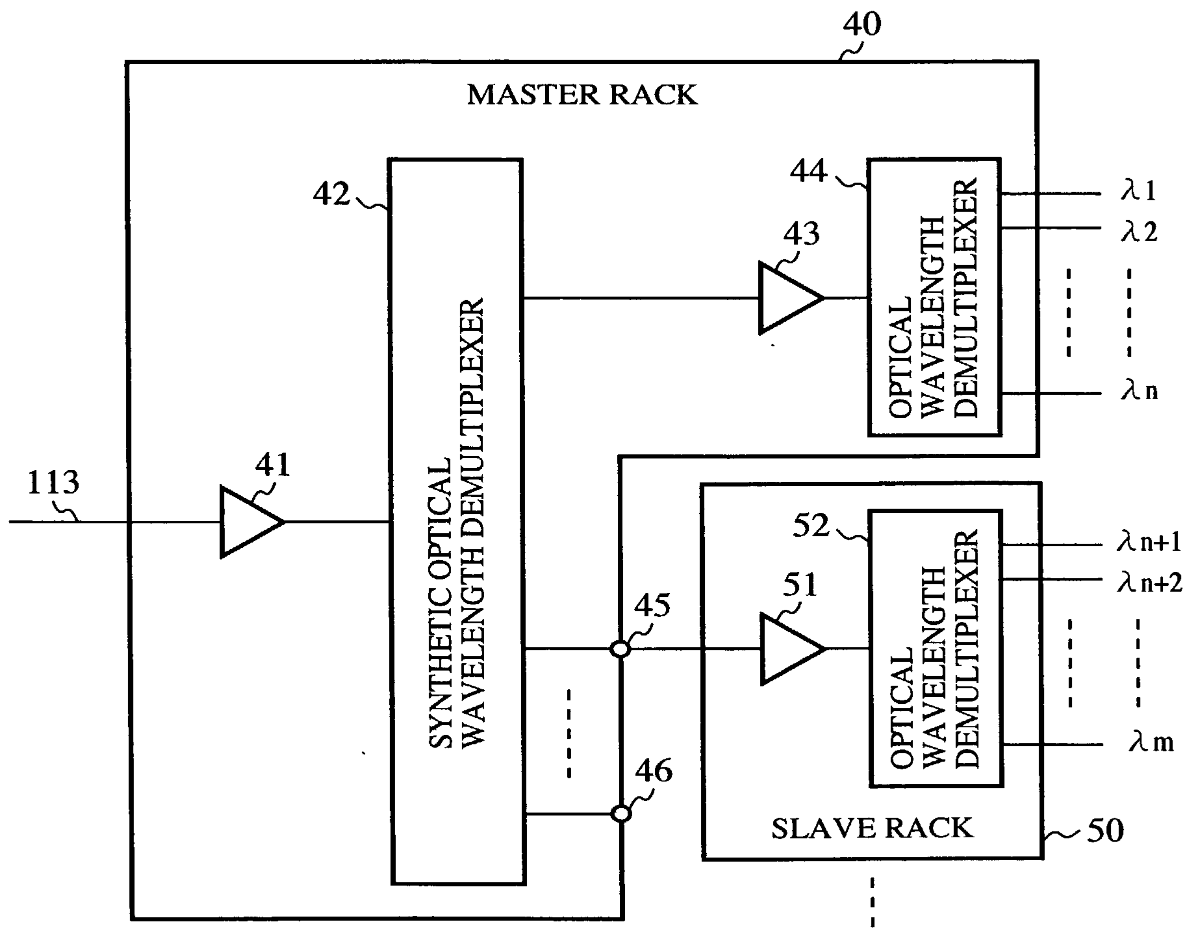

20
MASTER RACK
λ1
λ2
λn
21
OPTICAL WAVELENGTH MULTIPLEXER
22
23
SYNTHETIC OPTICAL WAVELENGTH MULTIPLEXER
24
113
λn+1
λn+2
λm
31
OPTICAL WAVELENGTH MULTIPLEXER
32
25
26
30
SLAVE RACK

FIG.3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MASTER RACK
42
SYNTHETIC OPTICAL WAVELENGTH DEMULTIPLEXER
44
43
OPTICAL WAVELENGTH DEMULTIPLEXER
λ1
λ2
λn
113
41
45
46
52
51
OPTICAL WAVELENGTH DEMULTIPLEXER
λn+1
λn+2
λm
SLAVE RACK
50

10/088503

FIG.4

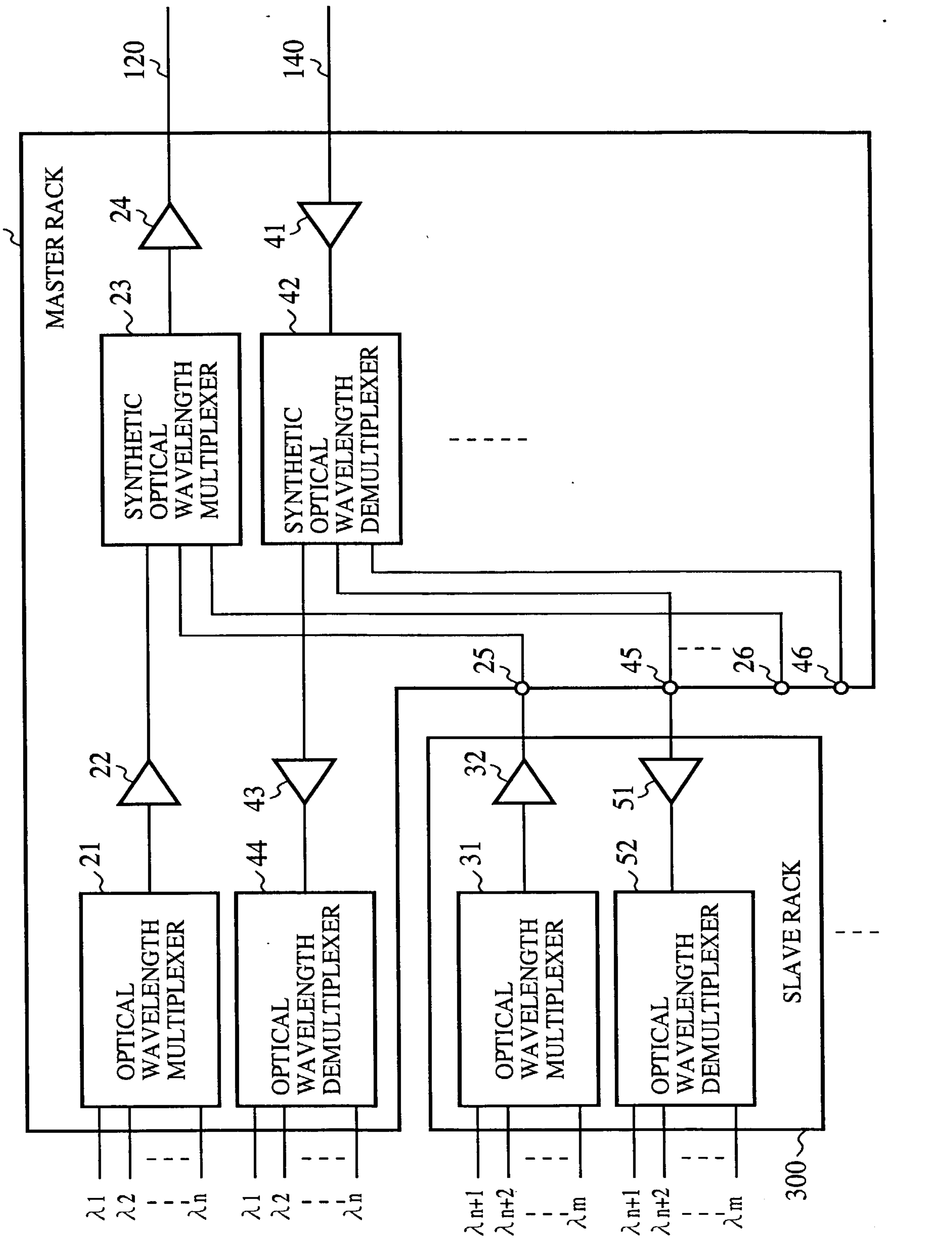
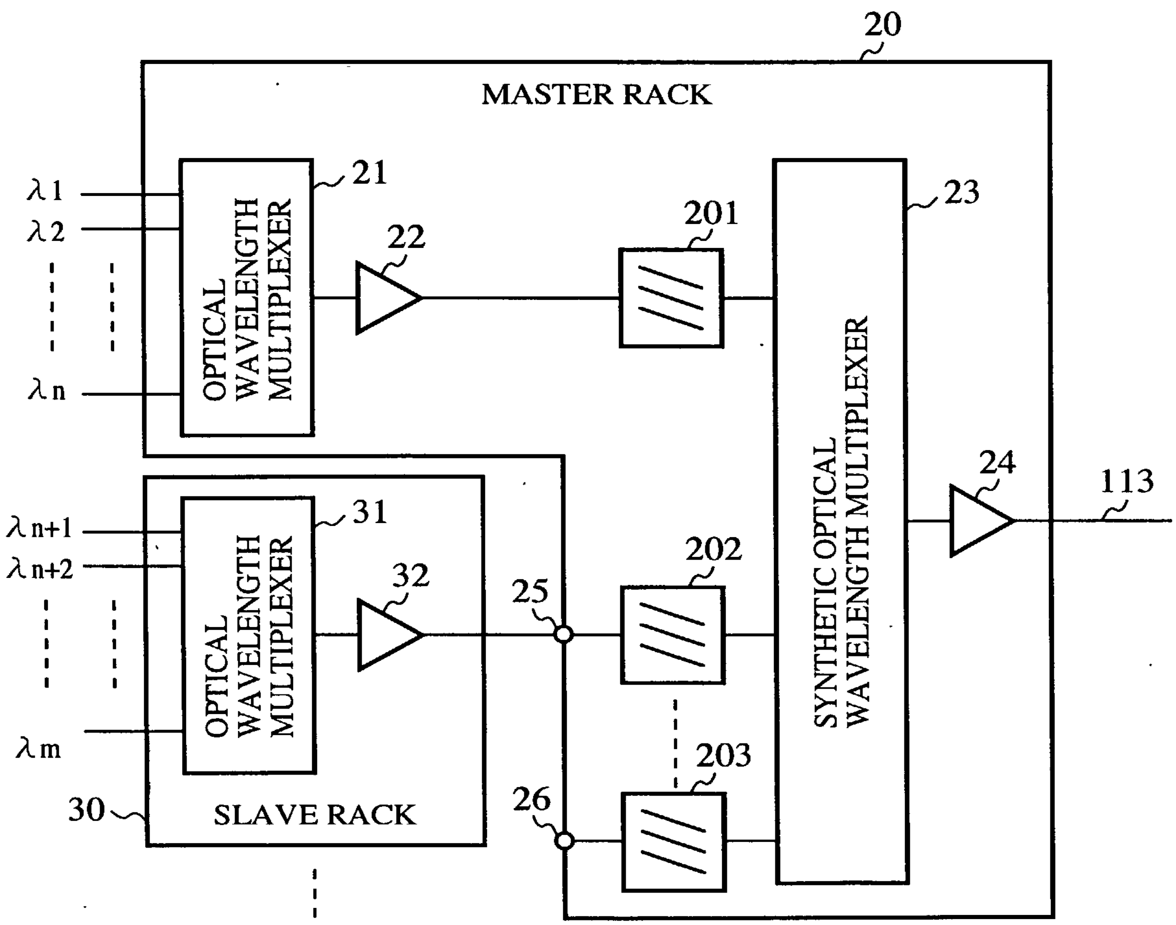


FIG.5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MASTER RACK
λ1
λ2
λn
OPTICAL WAVELENGTH MULTIPLEXER
21
22
201
23
SYNTHETIC OPTICAL WAVELENGTH MULTIPLEXER
24
113
λn+1
λn+2
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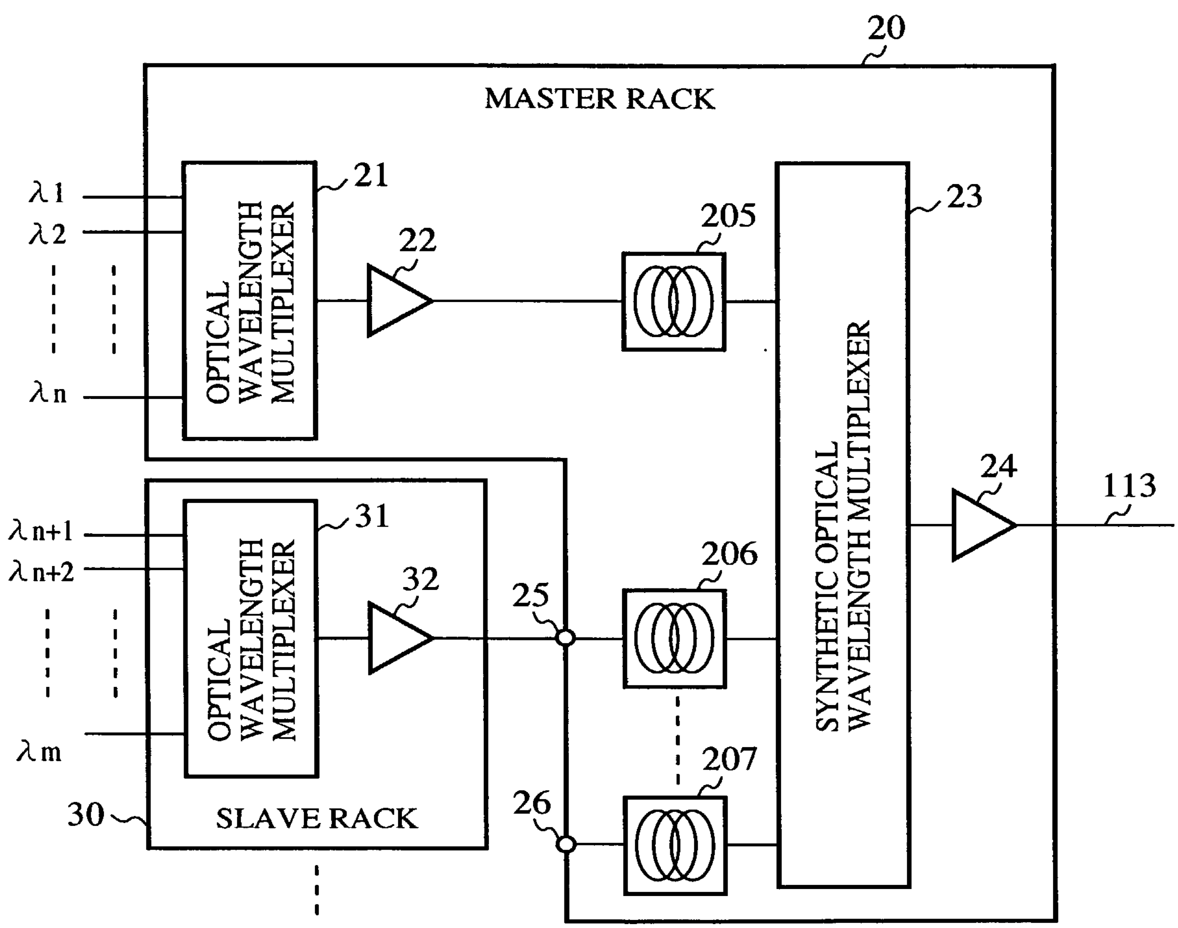
25
202
203
26
30
SLAVE RACK

FIG.6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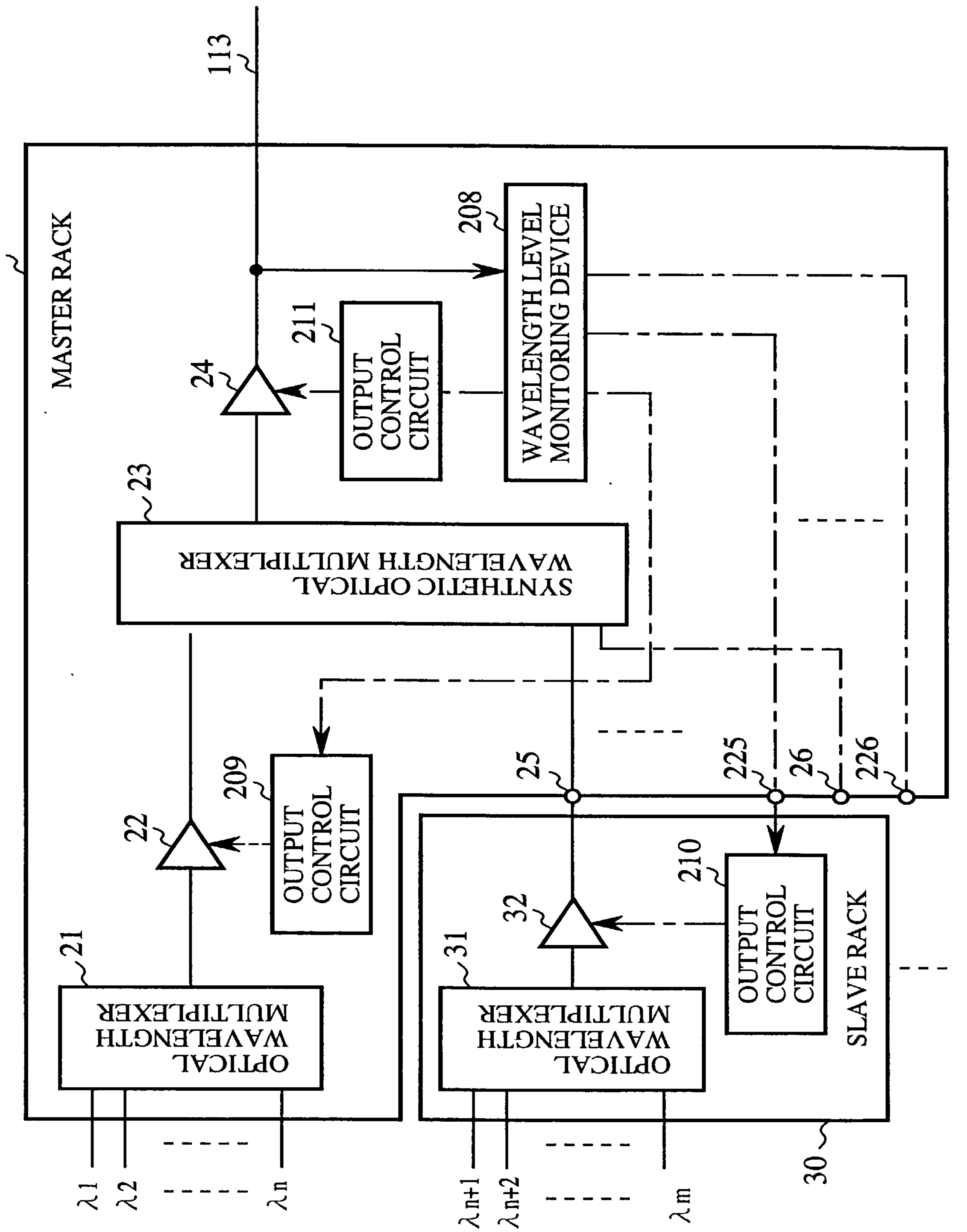
MASTER RACK
λ1
λ2
λn
21
OPTICAL WAVELENGTH MULTIPLEXER
22
205
23
SYNTHETIC OPTICAL WAVELENGTH MULTIPLEXER
24
113
λn+1
λn+2
λm
31
OPTICAL WAVELENGTH MULTIPLEXER
32
25
206
207
26
30
SLAVE RACK

FIG.7


20
MASTER RACK
113
208
WAVELENGTH LEVEL MONITORING DEVICE
211
OUTPUT CONTROL CIRCUIT
24
23
SYNTHETIC OPTICAL WAVELENGTH MULTIPLEXER
209
OUTPUT CONTROL CIRCUIT
22
21
OPTICAL WAVELENGTH MULTIPLEXER
λ1
λ2
λn
25
225
26
226
210
OUTPUT CONTROL CIRCUIT
32
31
OPTICAL WAVELENGTH MULTIPLEXER
SLAVE RACK
30
λn+1
λn+2
λm

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.
"OPTICAL WAVELENGTH DIVISION MULTIPLEXING AND TRANSMISSION APPARATUS"

上記発明の明細書は、
- ☐ 本書に添付されています。
- ☐ ＿月＿日に提出され、米国出願番号または特許協定条約国際出願番号を＿＿＿とし、(該当する場合) ＿＿＿に訂正されました。

the specification of which
- ☐ is attached hereto.
- ☒ was filed on 31/July/2000 as United States Application Number or PCT International Application Number PCT/JP00/05151 and was amended on ＿＿＿ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条（a）－（d）項又は365条（b）項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約365（a）項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Claimed 優先権主張	
			☐ Yes はい	☐ No いいえ
			☐ Yes はい	☐ No いいえ

私は、第35編米国法典119条（e）項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条（c）に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。
(弁護士、または代理人の指名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*

022850

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第二の共同発明者の氏名 2-00	Full name of second joint inventor, if any Takashi MIZUOCHI
第二の共同発明者の署名 日付	Second joint Inventor's signature Date Takashi Mizuochi Feb. 19, 2002
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(第三以降の共同発明者についても同様に記載し、署名すること)

(Supply similar information and signature for third and subsequent joint inventors.)

Japanese Language Declaration
(日本語宣言書)

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第三の共同発明者の署名 日付	Third joint Inventor's signature Date Katsuhiro Shimizu Feb. 19, 2002
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第五の共同発明者の署名 日付	Fifth joint Inventor's signature Date Shinichi Nakagawa Feb. 19, 2002
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第六の共同発明者の氏名 6-00	Full name of sixth joint inventor, if any Eiichi SHIBANO
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（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)

第七の共同発明者の氏名（該当する場合） 7-00	Full name of seventh joint inventor, if any Tadami YASUDA
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第八の共同発明者の氏名（該当する場合）	Full name of eighth joint inventor, if any
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第九の共同発明者の氏名（該当する場合）	Full name of ninth inventor, if any
同第九発明者の署名 日付	Ninth inventor's signature Date
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国籍	Citizenship
郵便の宛先	Post office address
第十の共同発明者の氏名（該当する場合）	Full name of tenth joint inventor, if any
同第十発明者の署名 日付	Tenth inventor's signature Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post office address